5.4b Fundamental Theorem of Calculus

proof of ftc

$F(x)$

I $\quad \frac{d}{dx}\int_a^{x} f(t)\,dt = f(x)$

$\frac{d}{dx}\left(F(x)-F(a)\right) = f(x)$

II $\quad \int_a^b f(x)\,dx = F(b)-F(a)$

$F(x) = \int f(x)\,dx$

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1.1 1.2 1.3 *Unsaved

$\frac{d}{dx}\left(\int_{-\pi}^{x}(\cos(t))\,dt\right) = \cos x$

$\frac{d}{dx}\sin t\Big|_{-\pi}^{x} = \frac{d}{dx}\sin x - \sin(-\pi) = \cos x + 0$

$\frac{d}{dx}\left(\int_{0}^{x}\left(\frac{1}{1+t^2}\right)dt\right) = \frac{1}{1+x^2}$

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1.2 1.3 1.4 *Unsaved

$\frac{d}{dx}\left(\int_{1}^{x^2}(\cos(t))\,dt\right) = \cos(x^2)\cdot 2x$

inside

outside

der of outside

der of inside

$\frac{d}{dx}\int_0^{x^3}\sin(x^2)\,dx = \sin\left((x^3)^2\right)\cdot 3x^2$

$\sin(x^6)\cdot 3x^2$

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1.3 1.4 1.5 *Unsaved

Find dy/dx

$y=\int_{x}^{5}(3t\sin(t))\,dt = -3x\sin(x)$

$y=\int_{2x}^{x^2}\left(\frac{1}{2+e^t}\right)dt = F(x^2)-F(2x)$

$\frac{dy}{dx} = 2x\,F'(x^2) - 2\,F'(2x)$

$= \frac{2x}{2+e^{x^2}} - \frac{2}{2+e^{2x}}$

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Find a function $y = f(x)$ with derivative $dy/dx = \tan(x)$ that satisfies the condition f(1)=2. Graph the function.

$x=1 \quad y=2$

$$y = \int_a^x \tan(t)\,dt$$

$$2 = \int_{a=1}^{1} \tan(t)\,dt + 2$$

$$y = \int_1^x \tan(t)\,dt + 2$$

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